The Effectiveness of Anti-Smoking Campaigns over the Life-Cycle and the Role of Information

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Abstract

Our study documents the effectiveness of anti-smoking campaigns on various age groups and attempts to shed some light on the mechanism by which community interventions operate and affect smokers. We re-examine evidence from a large scale National Cancer Institute community-wide intervention study entitled 'The Community Intervention Trial for Smoking Cessation' (COMMIT). Our empirical results show that this intervention has differential effects on the quit rates of smokers. This variation has not been observed in the earlier literature on anti-smoking campaigns and was not noticed by previous studies using the COMMIT data. The quit rates in the intervention group are found to be significantly higher for individuals aged 30 to 37 and those aged 60 and up, but lower for those younger than 30. The various channels of the COMMIT study were developed to create an awareness and recognition that smoking is a public health problem, and to change the social acceptability of smoking. In light of the age variation uncovered, we argue that the public information channel may play a crucial role in affecting change. In particular, public awareness about the negative health consequences of smoking is likely to be responsible for the increased quits among older smokers in the treatment group.

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1 Introduction

According to the Center of Disease and Control, in 2004, 20.9% of Americans were smokers.[1] Smoking is considered the 'leading preventable cause of death in the US', responsible for an estimated 440,000 deaths each year (or about 1 in 5 deaths).[2] As a result tobacco use remains one of the most critical public health concerns. In light of this, there has been a significant increase in state level tobacco control activities over the last decade. Modern comprehensive tobacco control programs generally include a combination of community wide interventions, countermarketing, policy and regulatory changes (usually in the form of increased tobacco taxes and the reinforcement of existing tobacco control policies) and evaluation activities. (CDC 2001) There have been a number of studies of the effectiveness of comprehensive tobacco control programs, Siegel (2002), Barnett, Hu, Sung, and Keeler (1995) and Farrelly, Pechacek, and Chaloupka (2003) are some examples. The evidence on the effectiveness of these programs has been positive. However, to our knowledge, there has been no work looking at how these community interventions operate, and on whom they are most effective.

The aim of this study is to shed some light on the mechanism by which community interventions operate and affect smokers. We will re-examine evidence from a large scale National Cancer Institute's (NCI hereafter) comprehensive community-wide interventions study entitled 'The Community Intervention Trial for Smoking Cessation' (COMMIT hereafter). Unlike other modern comprehensive tobacco control programs, COMMIT focuses on achieving smoking cessation through community channels, without relying on changes in public policy. Using individual level longitudinal data, we document which smokers are most affected by the COMMIT anti-smoking campaign. Given this information, we attempt to determine the mechanism through which these smokers might have been affected. In particular, we try to determine what role media and information play in encouraging particular groups of smokers to quit. Knowing who is affected by anti-smoking campaigns and understanding the mechanism through which campaigns encourage smokers to quit has important policy implications. It allows resources to be properly targeted at specific groups of individuals, and directed towards effective smoking cessation channels.

COMMIT was created to investigate the effectiveness of community level interventions in helping smokers achieve and maintain long-term smoking cessation. Its philoso-

[1] The prevalence rates for males and females are 23.4 % and 18.5% respectively. Refer to `http://www.cdc.gov/tobacco/research_data/adults_prev/prevali.htm`

[2] `http://www.cdc.gov/tobacco/research_data/adults_prev/mmwr5235a4.htm`

phy is to use social institutions as agents of change in the smoking behaviour of individuals. Its goals are to ensure that smoking is recognized as a public health problem, and to change the social acceptability of smoking, see (NCI 1995). The fundamental premise of COMMIT is that changes in social norms and information about the health consequences of tobacco use can influence individual behavior. In order to achieve these goals four main community intervention channels were employed: public education through the media and communitywide events; healthcare providers; work-sites and other organizations; and cessation resources.

The primary analyses of the results from the COMMIT study were published by COMMIT Research Group, (1995a) and (1995b), and the monograph *"Community Based Interventions for smokers: The COMMIT Field Experience"* published by NCI (1995). These studies focused on the univariate differences in the unconditional quit rates between the treatment (or intervention) and control groups for each participating state. They concluded that COMMIT failed to affect the quit rates of heavy smokers (smokers who smoked more than 25 cigarettes a day) but did increase the quit rates of light to moderate smokers by about 3%.

While the COMMIT study did not integrate changes in public policies (such as increases in excise taxes), there were nonetheless increases in federal and state cigarette excise taxes during this period. These earlier studies ignored this effect in their analysis. Farrelly, Pechacek, and Chaloupka (2003) provides a summary of other analysis of tobacco control programs which make similar assumptions.

In order to shed light on the mechanism by which smokers quit, we propose to analyze the quit rates of individual smokers conditioning on age and factors such as excise tax changes, using a regression framework. In so doing, we can attribute part of the heterogeneity in response to variation in observed characteristics across individuals and communities. This provides a tighter identification of the effect of treatment on the mean quit rates of individual smokers.

We find that the quit rates in the intervention group are significantly higher for individuals aged 30 to 37 (by around 3-4%) and for those aged 60 and up (by around 10%), but lower for those younger than 30 (again by around 3-4%). Treatment appears to have no effect on those aged 38-59.

In Section 5, we discuss how the intervention channels of the COMMIT campaign might operate to affect perceptions of the health consequences of quitting, or make overcoming addiction easier. We argue that the public information role of the COMMIT program is likely to be important in explaining some features of the identified quitting

profile by age. In particular, public awareness about the negative health consequences of smoking is likely to be responsible for the increased quits among smokers older than 60 in the treatment group.

The rest of the paper proceeds as follows. Section 2 describes the COMMIT study and relates it to modern comprehensive tobacco control programs. We provide some descriptive statistics for the data in Section 3. In Section 4, we compare the differences in quit rates between the treatment and the control groups. In Section 5, we propose a possible explanation for the quitting age-profile that is uncovered. Section 6 concludes.

2 The COMMIT Study

The main longitudinal dataset used in this study comes from a project entitled 'The Community Intervention Trial for Smoking Cessation' with the acronym COMMIT. This project was created to investigate the effectiveness of community level interventions in helping smokers achieve and maintain long-term smoking cessation. The study was funded by the National Cancer Institute (NCI) as part of its ongoing support for smoking cessation research.

The project began in 1989 and lasted until 1993. As COMMIT is a community level intervention study, the community was chosen as the unit of randomization. The study was conducted in 11 matched pairs of communities, 10 in the US, and one in Canada. A community is broadly defined to include a portion of a major metropolitan area or two small cities in the same geographical location. There is a distinct geographical boundary separating these communities to ensure independence of intervention activities and to minimize contamination. Selected communities were matched on general socio-demographic characteristics such as population size, demographic profile, (age, income distribution, ethnicity), smoking prevalence rate, access to intervention channels, etc. Tables 1 and 2, reproduced from NCI (1995), display some general demographic statistics, the smoking prevalence, and the quit rates in the communities enrolled in COMMIT. One of the communities in each pair was randomly selected as the intervention group (with the other acted as a control group).

COMMIT was designed to target *heavy cigarette smokers* whose smoking prevalence rates have been slower to decline than those of *light smokers*. (A *heavy smoker* is defined as someone who smokes more than 25 cigarettes a day and a *light smoker* as someone who smokes less than 25 cigarettes a day). Results published in the 1984 Surgeon

Table 1: Sociodemographic characteristics of community pairs.

Community/Area	Population	White (%)	Female (%)	Ages 25-64 (%)	High School Graduate (%)	Low Income (%)
Vallejo, CA ♣	120,060	52.1	50.2	51.1	80.7	17.1
Hayward, CA	141,893	63.5	50.8	53.9	75.3	16.3
Cedar Rapids/Marion, IA ♣	144,243	96.3	51.7	52.1	85	20.6
Davenport, IA	125,593	91	52.1	50.5	81.5	24.9
Fitchburg/Leominster, MA ♣	79,339	91.3	51.8	49.8	72	24.2
Lowell, MA	103,439	81.2	51.4	47.5	65.8	27.9
Paterson, NJ ♣	141,431	41.3	52.1	49.3	54.9	28.2
Trenton, NJ	91,688	42	51.3	49.9	58.2	29.7
Santa Fe, NM ♣	68,092	81.3	52.3	55.7	83.4	22
Las Cruces, NM	69,015	88.8	51	48.2	78.4	34.3
Yonkers, NY ♣	61,698	68.3	53.6	53	72.9	22.5
New Rochelle, NY	49,421	70.9	53.5	52.7	72.5	21.3
Utica, NY ♣	76,967	87.8	53.1	46.8	68.8	37.1
Binghamton/Johnson City, NY	73,632	93.2	53.1	47.8	74.2	35.8
Raleigh, NC ♣	232,652	70.8	51.5	54.8	86.5	18.9
Greensboro, NC	251,208	71.1	52.7	53.4	79	21
Medford/Ashland, OR ♣	66,832	94.7	52.4	49.1	83.4	29.8
Albany/Corvallis, OR	77,323	92.2	50.4	45.6	87.5	31.4
Bellingham, WA ♣	76,908	92.9	51.3	48.4	85.4	24.9
Longview/Kelso, WA	62,433	95	50.9	50.3	77.5	28.2
Brantford, Ontario, Canada ♣	88,525	a	51.5	50.7	56.3	14.9
Peterborough, Ontario, Canada	91,075	a	52.2	49.7	63.4	15
Mean for Intervention Sites	105,159	74.6	51.8	51.4	76.2	22.7
Mean for Comparison Sites	103,338	76.6	51.8	50.6	74.5	24.6

♣ - *Community randomised to receive intervention*

a - Data not available.

Table 2: Estimated smoking prevalence (by percent) and quit rates (by percent) in the COMMIT communities.

		Quit Rate		
Community/Area	Smoking Prevalence 1988	Rate for 2.5 Years, 1983-85	Rate for 2.5 Years, 1986-88	Rate for 5 Years, 1983-88
Vallejo, CA ♣	26.06	11.8	18.4	28
Hayward, CA	24.9	10.6	18.9	27.5
Cedar Rapids/Marion, IA ♣	22.35	14	18.8	30.1
Davenport, IA	26.22	14.2	16.3	28.2
Fitchburg/Leominster, MA ♣	26.27	12.2	17.5	27.6
Lowell, MA	29.08	11.1	16.9	26.1
Paterson, NJ ♣	26.49	7	14.5	20.5
Trenton, NJ	28.76	9.9	13.3	21.9
Santa Fe, NM ♣	21.96	16	22.5	34.9
Las Cruces, NM	19.54	13.6	21	31.7
Yonkers, NY ♣	24.76	11.8	18.4	28
New Rochelle, NY	24.87	14	16.9	28.5
Utica, NY ♣	26.49	11.9	16.9	26.8
Binghamton/Johnson City, NY	25.54	11.4	17	26.5
Raleigh, NC ♣	22.84	12.4	19.7	29.6
Greensboro, NC	25.67	11.8	16.9	26.6
Medford/Ashland, OR ♣	21.05	13.5	20.1	30.9
Albany/Corvallis, OR	18.29	13.2	19.2	29.8
Bellingham, WA ♣	20.1	13.1	22.6	32.8
Longview/Kelso, WA	25.53	12.7	18.3	28.7
Brantford, Ontario, Canada ♣	32.02	11.2	13.2	22.9
Peterborough, Ontario, Canada	28.06	10.3	17	25.6
Mean for Intervention Sites	24.45	12.3	18.4	28.4
Mean for Comparison Sites	25.44	12.1	17.4	27.4

♣ - *Community randomised to receive intervention*

a - Data not available.

General's Report show that while heavy smokers represent a third of all cigarette smokers, they account for half of all incidences of lung cancer and other smoking related cancers. Targeting this group of smokers using community-wide intervention channels became the central focus of the COMMIT study.

Prior to selection of the intervention community, a baseline telephone survey was conducted in each of these communities from January to May 1988. This was done using a modified random digit dialling technique with geographic screening methods to identify households in targeted areas. The purpose of this survey was to estimate the prevalence rate in these communities as well as to identify a sample heavy and light smokers in each of these communities.[3] The mean response rate was around 88%, with an average of 6000 households listed in each of the 22 communities. Groups of 550 heavy smokers and 550 light smokers between the age of 25 to 64 were identified in each community. A *smoker* is defined as an individual who has smoked at least a hundred cigarettes at the time of the survey and who is currently smoking.

A random sample of approximately 400 heavy and 400 light smokers in each community were assigned to the *end-point cohort*, from which the principal quit rates were to be estimated. The remaining smokers were assigned to the *evaluation cohort*. This latter group was used to assess the impact of COMMIT on intervention program awareness, receptivity and participation and to evaluate their perception of the social attitudes towards smoking. Cohort members were not explicitly informed of their status but were told that annual contact would occur. Individuals enrolled in the *end-point cohort* were told that they would be contacted briefly by telephone each year to determine their smoking status and to update tracking information. In 1993, individuals were contacted for the last time to assess their smoking status. A detailed set of questions were also asked to assess intervention program awareness and participation. All the analysis in this paper are conducted using the *end-point cohort*.

The intervention activities were organized through four community channels: health care providers, work sites and organizations, cessation resources and services, and public education through media and community-wide events. A set of mandated activities was specified for each of these channels. These activities were implemented through four task forces representing the four channels, each having a set of measurable objectives and goals. A system of records was also established to check and record the implementation of these activities.[4] For a detailed discussion of the activities conducted, readers should

[3]Interested readers should refer to the following references for a more detailed discussion about this project; COMMIT Research Group,(1996), (1995a), and NCI (1995).

[4]The mean level of attainment of goals and objectives across the 11 communities for the four task

refer to NCI (1995).

2.1 COMMIT and Comprehensive Tobacco Program

A number of states in the US have invested in large scale comprehensive tobacco control programs. According to *Investment in Tobacco Control State Highlights 2001* in 2001, the combined funds from federal, state, and private sources used in these state run comprehensive smoking prevention and tobacco control programs total to almost $1 billion. In per capita terms, this represents a spending of $3.38 per person in 2001. The state-level dedicated funds come from two primary sources, the 1998 Master Settlement Agreement between states and the tobacco industry and state cigarette excise taxes. California and Massachusetts were the first two states to use revenue from state excise tax increases to fund comprehensive tobacco control programs in 1989 and 1992 respectively. Their success was used in developing the guidelines outlined in *Best Practices for Comprehensive Tobacco Control Programs* CDC (1999) and encouraged many states to fund similar comprehensive programs. For example, Arizona established a comprehensive state program in 1995, Oregon in 1997, and Florida in 1998. See Siegel (2002) and Farrelly, Pechacek, and Chaloupka (2003) for discussions of the implementation and evaluation of these programs.

As mentioned in the introduction, the modern comprehensive tobacco control program has many similarities with the COMMIT study analyzed in our paper. Like these programs, the COMMIT program uses a combination of community wide interventions to achieve smoking cessation. While there were tax changes in the participating COMMIT states, tax revenues were not used to fund COMMIT activities. These tax changes, which we control for in our empirical analysis, were experienced by both the control and intervention communities.

At the time of the study, COMMIT was the largest community smoking intervention ever attempted. This eight year program sponsored by the NCI cost $45 million (refer to Lichtenstein, Wallack, and Pechacek (1992)). We do not have detailed funding information for the participating intervention communities. According to COMMIT Research Group (1995a), an average of $220,000 were spent to fund activities in each of the intervention communities. Taking into account the population of these intervention communities as reported in NCI (1995), the COMMIT funding amounts to around $1.90

forces is very high and varied around 90% and 93%. The four task forces implemented nearly all the designated objectives in a timely fashion.

per person. We will show in Section 4 below that this funding generates an increase in the aggregate quit rate for light smokers of around 2%. More importantly, we find that the effect of the intervention was largest for certain age groups. This modest level of funding increases the average quit rates for 30 to 37 year old light smokers by around 3% and, smokers older than 60 years by as large an amount as 10%.

Table 3: Selection of data

a) Base year (1989) sample

Sample of respondents at base survey	20347
Deleted obs. with incomplete age information	131
Deleted obs. with incomplete demographic information	1726
Deleted obs. with incomplete smoking history information	96
Sample with complete information at 1989	18394
(heavy smokers - 7460, light smokers - 10934)	

b) Pooled Sample from 1990 to 1993

Sample of pooled respondents from 1990-93	50309
Sample with complete age information	50136
Sample with complete age and demographics information	46599
Sample with complete age, demographics and smoking history information	46397
# of individuals who completed all 5 surveys (1989 to 1993)	8438

3 Descriptive Statistics

This section provides some descriptive statistics on the COMMIT data. Table 3 describes the selection process used to generate the final dataset for this analysis. Table 3a) shows the selection of observations in the base year 1989. In the base-year sample, we deleted 1953 observations due to incomplete age, demographic, and smoking history

information. This leaves a final sample of 18394 observations in the base year, of which 7460 and 10934 are classified as heavy and light smokers respectively. Table 3b) shows the selection process for the pooled sample of respondents from 1990 to 1993. The final pooled sample with complete information has 46397 observations. Of the 20347 smokers recruited from the 11 pairs of communities in 1989, a total of 8438 (around 42 %) completed all four annual interviews.

Table 4 shows some statistics for the various subsamples that completed all of the annual surveys. Individuals from the sample that stopped smoking over the entire length of the study (quit for all 4 periods) are on average older, and of higher average income than individuals in the sample that never quit, or that quit for only a single period. Individuals in this sample also smoke a smaller number of cigarettes on average upon enrolment in the study and started smoking at a later age. Further analysis of these data also shows that the subsample that successfully quit for the entire period of the study are on average more educated and hold more 'white collar' jobs. While most of these quantitative differences in means across subsamples are not statistically significant, Table 4 highlights much of the qualitative variations that we can expect from quit behaviors and various demographic characteristics. This qualitative feature also arises in the analysis of the data in Section 4.

Histograms (a) and (b) in Figure 1 display the age distribution at the start of the COMMIT study and the starting age reported during the first interview respectively for the entire sample and the sub-samples of heavy and light smokers. Heavy smokers are on average older, and started smoking at a younger age as compared to the sub-sample of light smokers. Studies looking at smoking addiction have consistently found that smokers who smoke more cigarettes are on average less successful at quitting. Heavier smokers typically require more attempts before being successful at quitting. This selection process resulting from smokers trying to overcome their addiction invariably generates this statistical feature of the data.[5] Histogram 1(c) shows the distribution of average number of cigarettes smoked in a day as reported in the first interview. The mean number of cigarettes smoked per day is slightly more than the equivalent of a pack of cigarettes (20 cigarettes), and the standard deviation is around half a pack. The data also appear to have considerable rounding error in reporting. This is responsible for the peaks in the distribution at one quarter intervals.

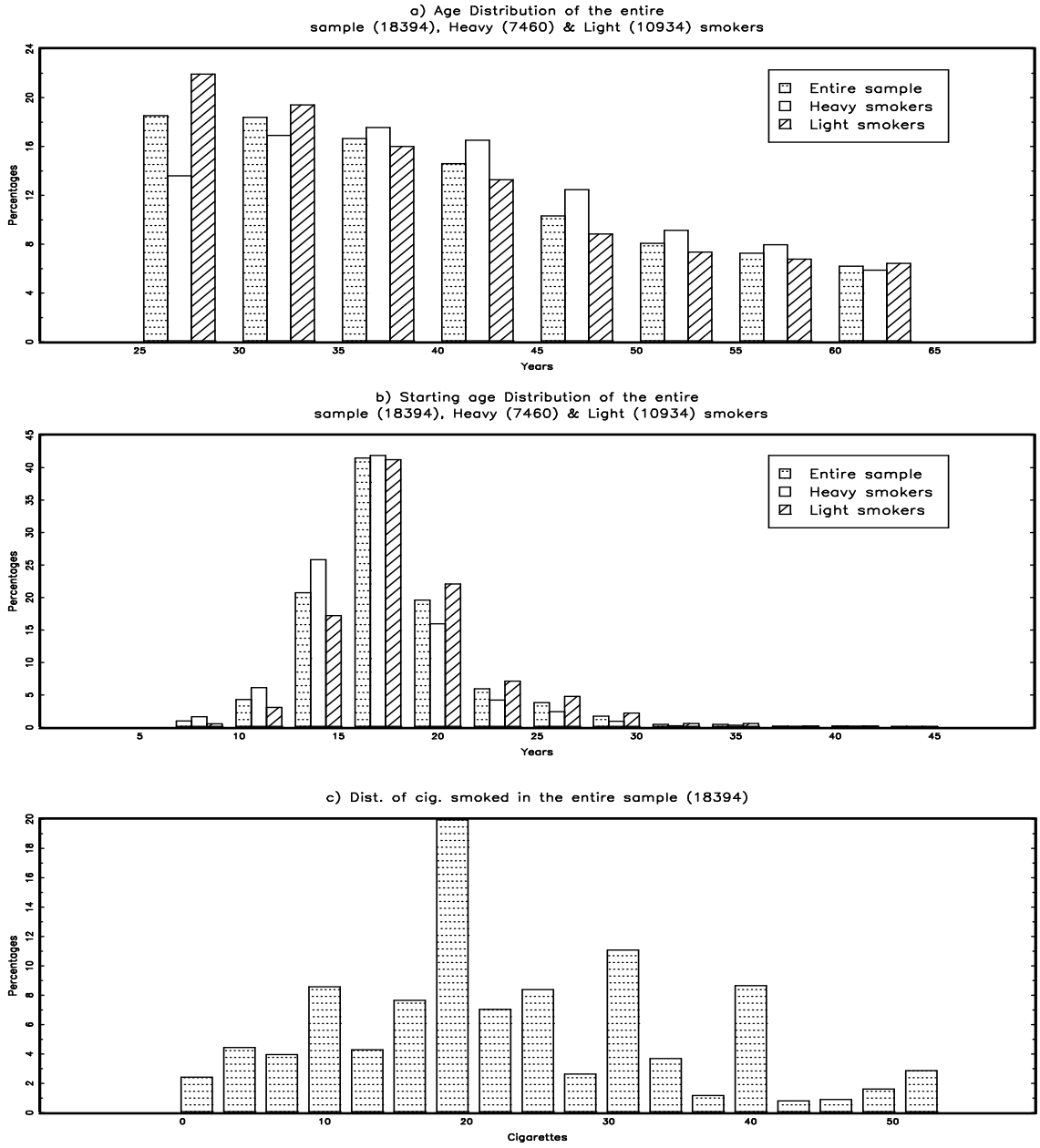
[5]A test of the null of equality of means between the heavy and light sub-samples suggests that the difference in the means of the two groups is statistically significant.

Table 4: Descriptive Statistics on various sub-samples

Variables	Sub-sample from respondents who completed all 5 surveys that never quits ($n = 4826$)	quit for 4 periods ($n = 952$)	quits for 1 period ($n = 1303$)	FULL sample ($n = 8438$)
Mean Age in 1989.	41.2 (10.3)	42.8 (11.3)	41.3 (10.6)	41.5 (10.6)
Mean cig. smoked in 1989.	25.2 (13.0)	19.3 (13.1)	22.7 (13.3)	23.3 (13.2)
Mean starting age	17.8 (3.9)	18.5 (4.4)	18.1 (4.3)	18.0 (4.1)
Quit Attempts > 24 hours	0.52 (1.91)	0.76 (1.49)	0.79 (2.82)	0.63 (1.98)
Proportion Males	45.7	47.5	50.3	47.3
Proportion with income $\leq$ \$25,000	40.1	34.8	35.5	37.9
Proportion with income $\geq$ \$40,000	26.8	31.3	30.5	28.5

Std. error in parenthesis.

Figure 1: Histograms of age and average cigarettes smoked



4 Analysis of the data - Quit Variation by Age.

The analysis of the results from the COMMIT study as published in COMMIT Research Group (February 1995a and February 1995b) has focused on the difference in the unconditional community quit rates between the intervention and the control group at the start and the end of the study. Heavy and light-to-moderate smokers were investigated separately. These researchers found that the quit rates were significantly higher in the intervention group for light-to-moderate smokers while the effect for heavy smokers was not found to be significantly different in the treatment group than in the control group.[6]

The purpose of this paper is to study the effect of the COMMIT campaign as it varies by age. Therefore, we propose analyzing the quit rates of individual smokers conditioning on various individual characteristics using a regression framework. We begin by looking at the variation in pooled quit behaviors of individual smokers across the two groups. We use two different measures of quit behaviors. The first, $QuitI$, is a discrete dependent variable that takes a value 1 if the respondent is no longer a smoker during the time of the interview and 0 if he or she is still smoking. We also constructed a second measure $Quit6mI$, which incorporates the length of each quitting spell. $Quit6mI$ takes a value 1 only if the respondent has stopped smoking for six months or more prior to the date of the interview. Again, unlike earlier work which focuses on the aggregated response at the beginning and at the end of the study, we pool together individual responses at each annual interview throughout the study. We omit data from the base interview in 1988/89 where every individual has a smoker.

$Intv$ is a dummy variable that takes a value 1 if the individual is part of the treatment group. *Age* is the age of the respondent during the time of interview.

One of the features of the dataset that is not ideal is the absence of any information about the purchasing behavior of the smoker or the price that they pay for their cigarettes. As a remedy, we have constructed a nominal weighted average price per cigarette for each state, denoted by P_t. This nominal weighted average price is taken from Table 13a Tobacco Institute (1994).[7] It includes state and federal levied excise tax but does not include municipal or county excise tax nor sales tax. The data for 1990 to 1994 take into account the generic brand category of cigarettes.[8]

[6]The COMMIT Research group also compared the quit rates between treatment and control by various demographic groups and smoking histories of smokers. Interested readers should refer to the above mentioned references as well as (NCI 1995).

[7]The Tax Burden on Tobacco was compiled by the now defunct Tobacco Institute.

[8]We have also repeated our analysis using real weighted average prices where we take nominal prices and subsequently deflate them by the CPI. Again the qualitative results using real weighted average

Tables 5 and 6 display results from a linear probability regression of $QuitI$ on various controls. Throughout this paper, we use the simple linear model because of the ease of interpretation of the parameter estimates. We have omitted similar regressions using the probit and logit counterparts.[9] The standard errors reported are clustered to allow for correlation between observations on the same individual.

Specifications 1a to 1d in Table 5 report results from the linear model using the pooled sample. The significant estimates on $Intv$ and P_t in Column 1a suggest that if we pool individual responses from the five-year study, we find that smokers are more likely to quit in the intervention communities and in states with higher prices. After accounting for excise-tax changes over the period of the study and quit variations by age, the quit rates of pooled smokers in the intervention group are around 1.3% higher than in the control. This is comparable to results published in COMMIT Research Group (1995a) and (1995b).The authors analyzed the mean difference in quit rates between the treatment and control group for heavy and light smokers separately. The mean differences for heavy and light smokers were reported as -0.007 and 0.030 respectively. Given that the pooled sample is divided almost equally between these two kinds of smokers, our estimate of 0.0128 is in the range of what earlier researchers using these data have found. We report the estimation results for the two separate groups of smokers in Table 6.

In specification 1b, we interact the treatment dummy $Intv$ with a cubic polynomial in age.[10] This allows us to identify differential quit responses by age across the treatment and control groups. As column 1b shows, the interaction coefficients are significant suggesting that there are significant differences in responses to community-level interventions by age. Notice that the coefficient on the treatment variable, $Intv$ also changes sign as a result of the interaction terms. The overall effect of treatment remains positive across all ages.

This significant differential response is robust and persists even after we include more controls. We add controls for education, race, income, and occupation of individuals in specification 1c. In specification 1d, we account for the degree of addictedness of smokers by including an indicator for the number of cigarettes smoked during the base year 1989, denoted by the variable C^{89}. In both of these specifications and others we

prices by state are the same.

[9]The qualitative results using these non-linear models are similar and are available from us upon request.

[10]We attempted a number of polynomial specifications and report the ones that we feel best represent the variation in the data.

Table 5: Pooled regressions using the full sample,
- Dependent variable: QuitI

Specifications	1a	1b	1c	1d
$Intv$	0.0128^{**}	-0.6670^{**}	-0.7114^{**}	-0.6942^{**}
	(0.0058)	(0.3044)	(0.316)	(0.3074)
P_t	0.1872^{**}	0.1876^{**}	1.8159^{**}	1.7027^{**}
	(0.074)	(0.0741)	(0.181)	(0.1774)
Age	-0.0098^{**}	-0.0094^{**}	-0.0134^{**}	-0.0073^{**}
	(0.0023)	(0.0032)	(0.0034)	(0.0033)
Age^2	0.0001^{**}	0.0001^{**}	0.0002^{**}	0.0001^{**}
	(2.55e-5)	(3.56e-5)	(3.75e-5)	(3.68e-5)
$Intv \times Age$		0.0481^{**}	0.0526^{**}	0.0505^{**}
		(0.021)	(0.0219)	(0.0213)
$Intv \times Age^2$		-0.0011^{**}	-0.0012^{**}	-0.0012^{**}
		(0.0005)	(0.0005)	(0.0005)
$Intv \times Age^3$		$8.01\text{e-}6^{**}$	$9.19\text{e-}6^{**}$	$8.71\text{e-}6^{**}$
		(3.43e-6)	(3.58e-6)	(3.49e-6)
R^2	0.0037	0.0039	0.0155	0.0476
# of obs	50136	50136	46599	46397
Occupation, Income, Race and Education controls included			√	√
Dummies for C^{89} included				√

clustered standard error in parenthesis,

** - sig. at the 5 % level, * - sig. at the 10% level

have attempted, this significant difference in quit rates by age across treatment and control remains. [11]

We investigate this further by estimating a dummy variable version of specification 1d. That is, we control for differentials in quit rates by age across the two groups using a set of dummy variables in place of the interaction variable $Intv \times Age$ used in specification 1d. Figure 1 plots the coefficients from the dummy variable regression and compares it to the polynomial estimated in Equation 1d. We note four points about the variation that is uncovered. First, the quit rates among the very young in the intervention group (that is, individuals aged 30 and below), are lower than in the control (by about 3%). Among individuals aged between 30 and 37, the quit rates in the intervention group are around 3-4% higher than in the control. Among the oldest in the sample, that is individuals aged 60 and above, the quit rates in the treatment group are around 10% higher than in the control. Finally, there is no obvious effect of the COMMIT campaign on individuals between the ages of 38-59.

These results suggest that the community level anti-smoking campaign is most effective in raising the cessation rates of individuals in their thirties and those over the age of 60. Surprisingly, all else equal, this intervention lowered the mean quit rates of the youngest smokers in the sample (between 24 and 30) by around 3%. From Figure 1, it is also apparent that the cubic polynomial captures much of the variation in differential quits rates between the treatment and control groups. We repeated this analysis using a more stringent measure of smoking cessation, $Quit6mI$. The results are qualitatively similar. The results are reported in the Appendix, interested readers should refer to Table 7 and Figure A1.

[11] We have chosen to omit the estimates of the other controls included in specification 1d. These results are not new and are consistent with the findings in other empirical papers (see for example Wasserman, Manning, Newhouse, and Winkler (1991) and Hu, Ren, Keeler, and Bartlett (1995)). In general, we find that smokers who are more educated and in higher income groups are on average more likely to quit; smokers who hold 'blue collar' jobs and those who smoke more during the base interview (that is, smokers who are more addicted) are less likely to quit.

Table 6: Regressions using Heavy and Light Smoker samples
- Dependent variable: QuitI

Specifications	2a	2b	2c	3a	3b	3c
$Intv$	0.0027	0.0295	0.0232	0.0208**	-0.9601**	-0.7535*
	(0.0082)	(0.0365)	(0.0378)	(0.0080)	(0.4029)	(0.4091)
P_t	0.2665**	0.2640**	1.6113**	0.1474	0.1482	1.7395**
	(0.1060)	(0.1062)	(0.2506)	(0.1011)	(0.1011)	(0.2446)
Age	0.0030**	0.0033**	0.0031**	-0.0075**	-0.0060	-0.0090**
	(0.0004)	(0.0006)	(0.0006)	(0.0030)	(0.0043)	(0.0043)
Age^2				0.0001**	8.04e-5*	0.0001**
				(3.37e-5)	(4.69e-5)	(4.82e-5)
$Intv \times Age$		-0.0006	-0.0005		0.0700**	0.0555*
		(0.0008)	(0.0008)		(0.0280)	(0.0285)
$Intv \times Age^2$					-0.0016**	-0.0013**
					(0.0006)	(0.0006)
$Intv \times Age^3$					1.21e-5**	9.95e-06**
					(4.60e-6)	(4.71e-06)
R^2	0.0067	0.0067	0.0153	0.0030	0.0037	0.0471
# of obs	20672	20672	18989	29464	29464	27408
Occupation, Income, Race, Education and C^{89} controls included			√			√
Sub-sample	Heavy smokers i.e. $C^{89} \geq 25$			Light smokers i.e. $C^{89} < 25$		

clustered standard error in parenthesis, ** - sig. at the 5 % level, * - sig. at the 10% level

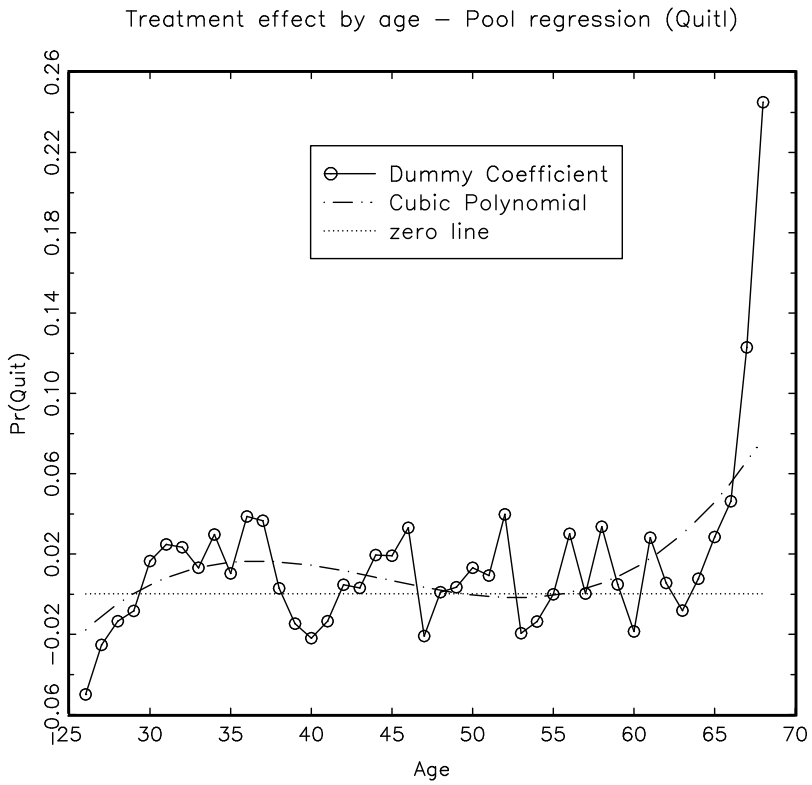


FIGURE 1

Table 6 reports the estimation results for the sub-sample of heavy and light-to moderate smokers separately. Specifications 2a to 2c use the subsample of heavy smokers while specifications 3a to 3c use the sample of light-to-moderate smokers. Recall that heavy smokers are those who smoked on average 25 or more cigarettes a day during the base interview in 1988 while light-to-moderate smokers smoked less than 25 cigarettes a day on average. The significant positive estimates of the coefficient on P_t and Age in 2a and 2b suggest that heavy smokers are more likely to attempt to quit as they age, and in states where prices are higher. The insignificant estimates of $Intv \times Age$ suggest that there is no significant difference in quit rates between the treatment and control group among heavy smokers. We attempted a number specifications of higher order polynomials and found that the interaction estimates remained insignificant. Adding more controls in the case of specification 2c also does not change this result.

We now turn to the sample of light-to-moderate smokers. The significant estimates

on Age^2 and Age^3 suggest that the overall quit pattern by age for the full sample shown in Table 5 is largely driven by the sample of light smokers. Similarly, the significant estimates on the interaction of Age and $Intv$ also suggest that the quit rate differential by age between the treatment and control uncovered in the full sample is also driven by variations in this subsample of light smokers. The insignificant estimate on prices, P_t in specification 3a and 3b suggests that light smokers are not as sensitive to price variations as heavy smokers. We repeat our earlier exercise of estimating a dummy variable regression of specifications 2c and 3c. The graphs of the dummy variable coefficients are shown in Figure 2.

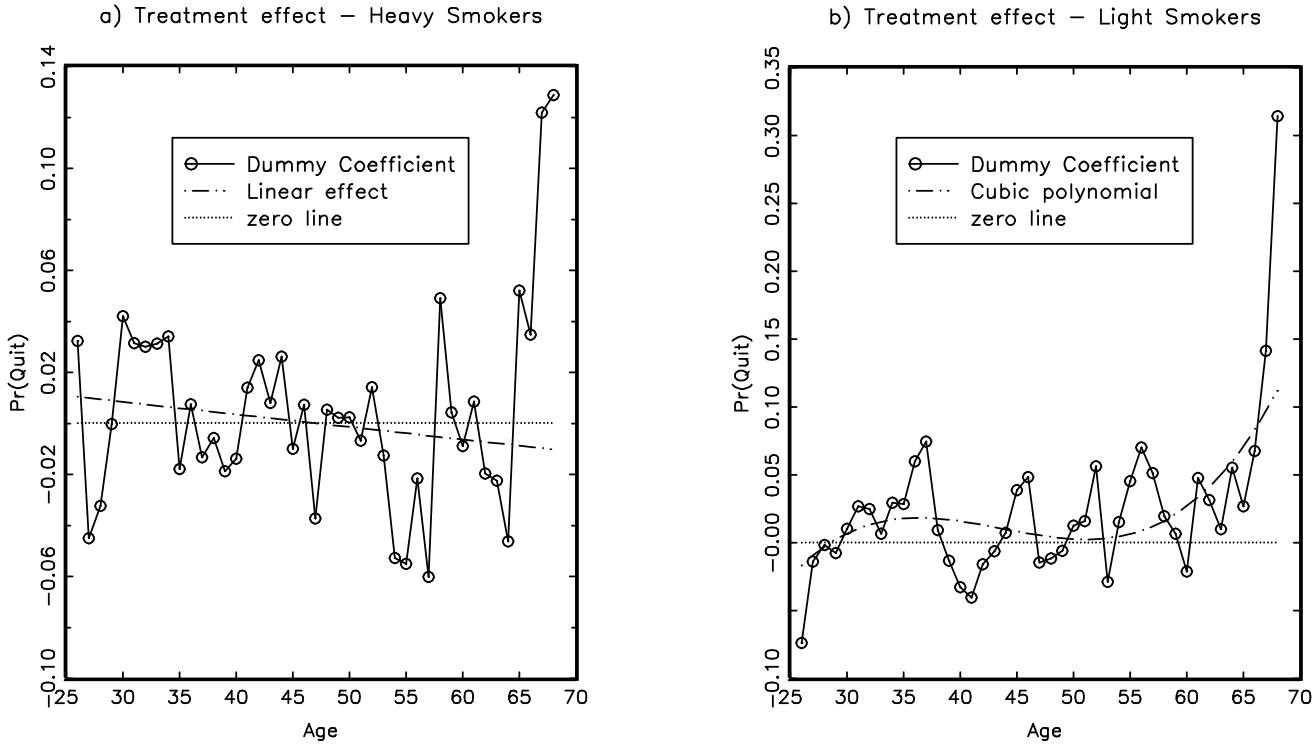


FIGURE 2

The results listed in Table 6 highlight two facts. First, the intervention program has the largest effect on the sample of light-to-moderate smokers. Our results are consistent with the findings of the COMMIT Research Group. Like this earlier work, we find that the community-wide intervention has no significant effects on the quit rates of heavy smokers. As for light smokers, after accounting for variation from excise tax changes, we

find that the quit rates for light smokers in the intervention communities are on average 2% higher than the control group. This is 1% lower than the results reported in earlier work (which ignore variation from excise tax changes).

Second, we find that community level intervention programs affect smokers of various ages differently. The uncovered age variation in quit rates is significant and has not been noted in previous work. Most of this differential variation by age comes from the quit behavior of light smokers (who smoke less than 25 cigarettes a day). The quit rates in the intervention group are significantly higher for individuals aged between 30 and 37 and those aged 60 and above. We still observe that light smokers between 25 and 30 years old are less likely to quit in the treatment group.

5 Interpreting the Quit variation by age

In this section, we attempt to provide an explanation for the differential in quit rates uncovered in the empirical section of this paper. In particular we try to link the stated goals of the COMMIT campaign with the observed change in behavior in the treatment group relative to the control group.

As mentioned above, one of the primary channels used in the COMMIT campaign is advertising: public education through the media and communitywide events. One potential purpose of advertising is to limit the problems caused by imperfect consumer information. Market inefficiencies may arise if consumers are not aware of a product's existence, price, or characteristics. Advertising represents a potential solution to this information problem (see Stigler (1961), Butters (1977), and Grossman and Shapiro (1984)). So anti-smoking public education through the media or community events is most likely informative in the sense that it provides information to consumers about the negative health consequences of smoking, and the kinds of resources available to help smokers quit. Such information might also be provided by healthcare professionals in the COMMIT campaign.

There has been some work done to test empirically whether, for particular advertising campaigns, advertising is indeed providing information (rather than affecting preferences as it would if advertising were persuasive). In particular, Ackerberg(2001) and (2003) and Anand and Shachar (2004) make use of consumer heterogeneity to identify whether advertising is informative or persuasive in different markets.[12] The idea is that informa-

[12]Ackerberg (2001) examines advertising for a newly introduced brand of yogurt. Anand and Shachar

tive advertising should have a different effect on different consumers and that advertising can increase the likelihood that a consumer selects a product with which he is a good match given his characteristics and the product's characteristics.[13]

In the context of smoking, the uncertainty of individuals is over the health consequences of smoking. Smokers get information about these consequences from their personal experience, word-of-mouth, and anti-smoking campaigns. Exposure to anti-smoking advertisements that highlight the negative health consequences should increase the likelihood of quitting for smokers that are at-risk of suffering these health consequences.

Numerous studies suggest that smokers often only change their behaviour when they actually experience negative health shocks. Since smokers are far more likely to experience adverse health shocks as they age, this may explain why cessation rates increase with age. (see Clark and Etilé (forthcoming), Clark and Etilé (2002), and Falba (2005)). The evidence suggests that as smokers age, health concerns and negative health events become important initiators of smoking cessation.[14] An anti-smoking message from the COMMIT campaign may provide information to an older smoker that, for them, the benefits from quitting smoking outweighs the costs of quitting.[15] So informative messages should have a greater effect on older people since negative health consequences only arise as a person ages.

Moreover, there is a tendency, in the absence of information about the benefits of cessation, for older individuals to believe that there is no sense in quitting. One reason older individuals might be less likely to quit is that, having smoked for so long, they feel that the damage they have done to their bodies is too great, and that as a result there are no benefits to quitting. In the Surgeon General's Report of 1990 on the health benefits of smoking cessation, reference is made to a 1989 Gallup survey that suggests that the proportion of smokers who say they would like to give up smoking is decreasing

(2004) look at previews for upcoming television shows.

[13]In Ackerberg (2001), consumers that have bought the brand of yogurt in the past are experienced with the product in the sense that they know its characteristics and the utility that they can expect to derive from it and so they should not be affected by advertising that provides information about existence or product characteristics. Anand and Shachar study a model in which consumers are uncertain about the attributes of different products. They get information about these attributes from various sources – experience with the product, word-of-mouth, advertisements, etc. The informative role of advertising can be identified off the fact that exposure to advertising should increase a consumer's familiarity with a product and should therefore increase the likelihood that he selects a product that is suitable for him given his characteristics (a product with which he is a better match).

[14]And of course, as smokers age, they also get more opportunities to attempt to quit.

[15]In other words, these individuals, because of their age, are a better match with the alternative 'quit smoking' than with the alternative 'continue smoking'.

in age (see Chapter 1 of the 1990 Surgeon General's Report, US Dept. of Health of Human Services (1990)). The report provides a number of possible explanations for this decrease, among them that individuals believe that whatever damage they have done to their bodies is irreversible and as a result it is not worth quitting. So some individuals that experience negative health shocks might believe that nothing can be done.

The COMMIT program's role may be to pass on information that there are always important benefits to quitting. Medical evidence suggests that the health benefits from quitting extend to the elderly. Furthermore, there is strong evidence that there are benefits to quitting even for those that already suffer from some smoking related illness.[16] Given that treatment significantly increased the quit rate of the oldest smokers who are also most at-risk of a negative health shock, we argue that this is evidence in support of the informational role of the COMMIT programme.

Unfortunately, we cannot extend the argument that the COMMIT campaign primarily disseminated information about the health benefits of quitting in such a way as to explain the rest of the quit profile. Medical evidence suggests that cessation at younger ages yields an even greater proportionate increase in the likelihood of survival than does quitting later in life.[17] Therefore, if the COMMIT campaign provides information on the health benefits of quitting, younger smokers should be influenced relatively more than older smokers since they stand to gain the largest increase in life expectancy. This would mean that younger smokers are more likely to quit in the treatment group which contradicts what we observe in the data. There may also be some interplay between the health benefits of quitting and the costs of doing so. However, if we assume that the cost of quitting for smokers is largely a function of their level of addiction, we can assume that the costs of quitting are increasing in age. In Section 7A of the Appendix, we provide empirical evidence that suggests that older smokers are on average more addicted to cigarettes and so the cost of quitting should be smaller for younger smokers. Again this would suggest that we should observe that younger smokers are on average more likely to quit, which we do not. The fact that we observe that the youngest smokers in the sample are actually less likely to quit in the treatment group suggests that there is some sort of backlash on their part against the type of intervention provided by

[16]See Chapters 1 and 3 of The 1990 Surgeon General's Report, US Dept. of Health of Human Services (1990). The Report points out that the risk of recurrent heart attack and cardiovascular death can be reduced by 50% or more by quitting smoking. Quitting also reduces the risk of amputation following peripheral artery surgery and increases the overall likelihood of surviving such an operation. There are also potential benefits to quitting for smokers diagnosed with gastric and duodenal ulcers, cancers, and in all likelihood those that have suffered strokes.

[17]Refer to Tables 7 and 8 of Chapter 3 of the 1990 Surgeon General's Report.

the COMMIT program. At this point, our analysis does not permit us to say anything about the possible reasons for this backlash.

As mentioned above, another function of the COMMIT campaign is to provide cessation resources to smokers, and these may lower the costs of overcoming addiction. It is possible that the impact of this channel of the campaign helps to explain the observed profile, but this cannot be identified in the data and so, at this stage, we are unable to pinpoint the channel (or channels) of the COMMIT campaign that is (are) responsible for generating the rest of the quit age profile.

Our empirical evidence suggest that there is a fundamental difference in responses between young and old smokers to community level interventions and that this strong heterogeneity in responses needs to be considered when developing community level tobacco control policies.

6 Conclusion

In this paper we have documented the effectiveness of a large scale National Cancer Institute community-wide intervention study. Like earlier work on the COMMIT study we find that the program has a significant effect on cessation of light to moderate smokers but not on heavy smokers. Our contribution to the literature is to show that the effectiveness of the program varies with the age of smokers. Our empirical results show that this intervention has differential effects on the quit rates of smokers. This variation has not been observed in the earlier literature on anti-smoking campaigns and was not noticed by those studying the COMMIT programme in previous work. The quit rates in the intervention group are found to be significantly higher for individuals aged 30 to 37 and those aged 60 and up, but lower for those younger than 30. There is no obvious effect one way or the other for those aged 38-59. We argue that the impact on the oldest in the population results from the fact that information about the health benefits of cessation provided through the COMMIT program has a stronger effect on these individuals since they are the ones experiencing negative health shocks. At this point we cannot identify the channel (or channels) of the COMMIT program that is (are) responsible for generating the rest of the quit age profile.

7 Appendix

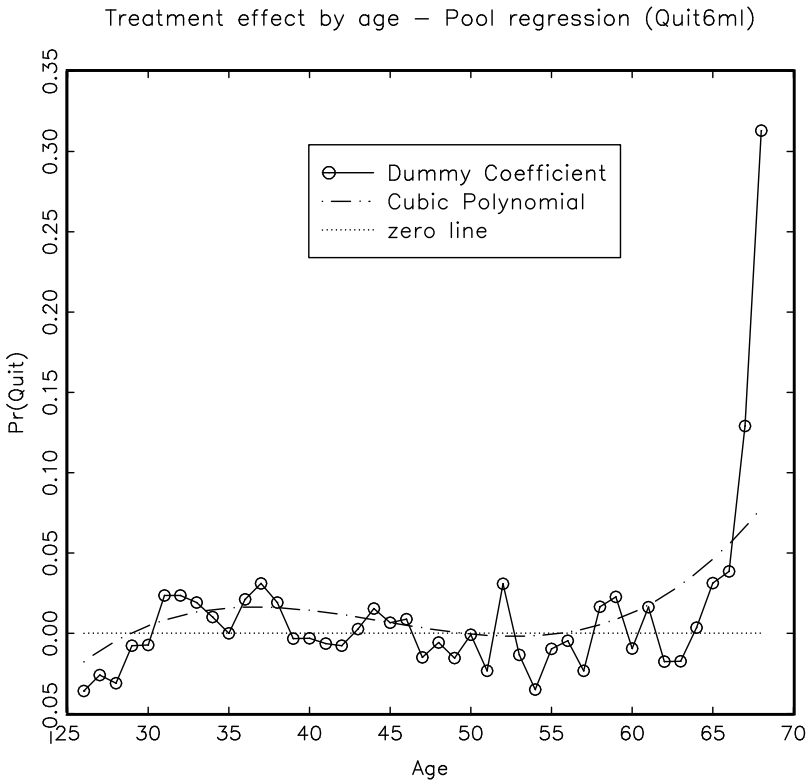


FIGURE A1

7A. Cost of Quitting

A number of factors might influence the cost of quitting, but we can suppose that the primary influence is the level of addiction of a smoker. Think of the cost of quitting as being a function of how difficult it is to overcome addiction. The more addicted a smoker is, the harder it is for them to quit.

In Table 8 we show that age is positively correlated with various measures of addiction. That is, older smokers are on average more addicted to cigarettes. In regression 4a), age of smokers is regressed on their respective starting age. A coefficient significantly less than 0.5 is consistent with the observation that most smokers starts smoking around the age of 18 and very few pick up this habit after the age of 22, For example, Table 7 on page 49 of US Dept. of Health of Human Services (1994) shows using data from the 1991 National Household Survey on Drug Abuse that of adults who smoked daily,

Table 7: Pooled regressions using the full sample,
- Dependent variable: $Quit6mI$

Specifications	A1a	A1b	A1c	A1d
$Intv$	0.0073	-0.9783^{**}	-1.0200^{**}	-1.0127^{**}
	(0.0049)	(0.2593)	(0.2698)	(0.2651)
P_t	0.2089^{**}	0.2095^{**}	1.9674^{**}	1.8928^{**}
	(0.0634)	(0.0634)	(0.1514)	(0.1496)
Age	-0.0060^{**}	-0.0054^{**}	-0.00875^{**}	-0.0048^{*}
	(0.0020)	(0.0027)	(0.0028)	(0.0028)
Age^2	$9.08e-5^{**}$	$8.34e-5^{**}$	0.00012^{**}	$7.82e-5^{**}$
	(2.18e-5)	(3.04e-5)	(3.18e-5)	(3.19e-5)
$Intv \times Age$		0.0699^{**}	0.07409^{**}	0.0731^{**}
		(0.0180)	(0.0188)	(0.0184)
$Intv \times Age^2$		-0.0016^{**}	-0.00171^{**}	-0.0017^{**}
		(0.0004)	(0.0004)	(0.0004)
$Intv \times Age^3$		$1.17e-5^{**}$	$1.27e-5^{**}$	$1.25e-5^{**}$
		(2.98e-06)	(3.12e-06)	(3.05e-06)
R^2	0.0058	0.0065	0.0171	0.0346
# of obs	49441	49441	45952	45786
Occupation, Income, Race and Education controls included			$\surd$	$\surd$
Dummies for C^{89} included				$\surd$

clustered standard error in parenthesis,

** - sig. at the 5 % level, * - sig. at the 10% level

71.2 percent of them had begun daily smoking by the age of 18.[18] As such, we expect older smokers (all else equal) to be on average more addicted than to younger smokers (see also DeCicca, Kenkel, and Mathios (2002)). Hence older smokers on average have longer smoking history and so have more time to become addicted. In specification 4b, age is shown to be positively correlated with another measure of addiction, the average number of cigarettes smoked per day.

As part of the base year interview, smokers were also asked how long after waking up would they have their first cigarettes. Specification 4c considers the correlation of age with the dummy variables representing time to first cigarettes. The omitted category is 'First cigarette within the first 10 minutes'. The significant coefficients for category '30 min - 1 hr' onwards suggest that smokers who start smoking later in the day are on average younger. For example, smokers who start smoking an hour and the half after waking are on average at least 3.5 years younger than those who start smoking in the first 10 minutes.

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[18] See also Table 9 on Page 50 and 51 of US Dept. of Health of Human Services (1994).

Table 8: Regression of Age and measures of Addiction,
- Dependent variable: Age at 1989

Specifications	4a	4b	4c
Starting Age	.4036**		
	(.0171)		
C_t at 89		.0765**	
		(.0056)	
Time to first cigarette			
10 - 30 min			−.1326
			(.1932)
30 min - 1 hr			−1.2678**
			(.2238)
1 - 1.5 hr			−1.7667**
			(.3672)
1.5 - 3 hr			−3.5825**
			(.3039)
> 3hr			−3.7492**
			(.2782)
constant	33.1627	38.5418	41.2615
	(.3170)	(.1535)	(.1304)
# of obs	20216	20085	20148

robust se in parenthesis, ** indicates sig at the 5 % level

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